Core RF Test board report #4

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Background.

Validation of results from ACX (in test report QEC-1308092), final PCB layout and u.FL performance.

Equipment used.

Agilent N5230A. 4 port VNA – good to 20GHz, in cal.

Configurations tested.

Analysis of ACX report suggests the V3 layout and the Case 6 component values (see Figure 1) will yield the best result possible. Validate the results using the Johanson eval kit components. This leads to component choices of 3.3nH and 1pF – any difference from the ACX report values will be swamped by component tolerances and/or assembly variances.

In addition, measure the u.FL performance for the V3 layout – which was not performed by ACX.

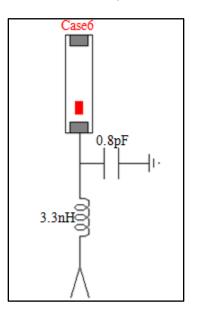


Figure 1. Matching circuit and values from ACX report.

Four RF test boards (numbered 3-01 thru -04) were populated with u.FL connectors and four RF test boards (numbered 3-05 thru -08) were populated with 3.3nH 0603 series inductor (Johanson part

number L-143N3SV4), 1pF 0603 shunt capacitor (Johanson part number 251R14S1R0BV4) and ACX8010 antenna.

Measured results.

The u.FL connectors uniformly showed a transmission loss of approx. 0.5 - 0.75dB. This is acceptable, and may be improved in the production version by increasing the groundplane to microstripline clearance in the vicinity of the connector. Representative results are shown in Figures 2 and 3.

File View Cha	nnel Sweep	Calibration T	irace Sca	le Marke	r System	n Windov	w Help			
Stimulus		Start 2.3	50000000 0	àHz 🗧	Start		Stop	Cen	ter	Span
S21 1.000dB/ Tr2 -4.00dB LogM		dB S21 Sdd	11 & Sdd2	2 OdB is a	Sdd12 -1	DdB				
4.00dB LogM	0.00									
	-1.00									
	-2.00									
	-3.00									
	4.00									
	-5.00									
	-6.00									
	-7.00									
	-8.00									
	-9.00	1: Start 2.35000	GHz —						Stop 2.5	5000 GHz
Cont. CH 1	: <mark>S21</mark>		C 2-Por	t					l	.CL

Figure 2. Test Board #3-01 S11 response

File View Char	nnel Swe	-				er System	n Windo	w Help			
Stimulus		S	tart 2.35	00000000	àHz 🗧	Start		Stop	Cen	ter	Span
<mark>S21</mark> 1.000dB/ Tr2 4.00dB LogM	1.00 T	72 <mark>dB S21</mark>	Sdd	11 & Sdd2	2 OdB is a	: Sdd12 -1	DdB				
	-1.00										
	-2.00										
	3.00										
	4.00										
	5.00										
	6.00										
	-7.00 -										
	8.00										
	9.00	Ch1: Start	2.35000	GHz —						Stop 2.5	55000 GHz
Cont. CH 1	Cont. CH 1: S21 C 2-Port LCL										

Figure 2. Test Board #3-01 S21 response

File View Cha	nnel Sweep	o Calibration T	race Scale M	arker System	Window Help						
Stimulus		Start 2.35	0000000 GHz	🗧 🛛 Start	Stop	Center	Span				
<mark>S21</mark> 1.000dB/ Tr2 -4.00dB LogM	1.00 Tr2	dB S21 Sdd	11 & Sdd22 OdB	is a: Sdd12 -1Dd	В						
	-1.00	···				т — .					
	-2.00										
	-3.00 —										
	4.00										
	-5.00										
	-6.00										
	-7.00										
	-8.00										
	9.00	1: Start 2.35000	GHz —			Stop 2	.55000 GHz				
Cont. CH 1	Cont. CH 1: S21 C 2-Port LCL										

Figure 3. Test Board #3-03 S21 response.

Test board #3-05 malfunctioned, and the results are not reported.

Figures 4-6 show the S11 plot for the remaining 3 boards with chip antennas.

File View Cha	nnel Sw	eep Calib	ration Ti	race Sca	ale Marke	er Systen	n Windo	w Help			
Stimulus		S	tart 2.35	00000000	GHz 🕂	Star		Stop	Cen	ter	Span
<mark>S11</mark> 5.000dB/ Tr1 0.00dB LogM	5.00 0.00	Tr1 dB S11	Sdd	11 & Sdd2	2 OdB is a	: Sdd12 -1	DdB	1: >2:	2.400000 2.480000		-14.174 dB -10.054 dB
	-5.00										
	-10.00							2			
	-15.00			1			K				
	-20.00					_/					
	-25.00				\rightarrow	/					
	-30.00				-						
	-35.00				~						
	40.00										
	45.00	>Ch1: Start	2.35000	GHz —						Stop 2	.55000 GHz
Cont. CH 1				No Cor						3.06 6	LCL

Figure 4. Test Board #3-06 S11 response

File View Cha	nnel Sweep	Calibration T	race Sca	ile Marke	er System	n Windov	w Help			
Stimulus		Start 2.3	50000000 0	âHz 🛨	Start		Stop	Cen	ter	Span
<mark>S11</mark> 5.000dB/ Tr1 0.00dB LogM	5.00 Tr1 d	HB S11 Sdd	:11 & Sdd2	2 OdB is a	: Sdd12 -1	DdB	1: > 2:	2.400000 2.480000		9.7446 dB -11.088 dB
	-5.00									
	-10.00		1				2			
	-15.00					-/				
	-20.00					/				
	-25.00				\searrow					
	30.00									
	35.00									
	40.00									
	45.00	: Start 2.35000							Share 21	55000 GHz
	,	: start 2.35000								
Cont. CH 1	: S11		No Cor							LCL

Figure 2. Test Board #3-07 S11 response

File View Cha	nnel Swe	eep Calib	ration T	race Sca	ale Marke	er System	n Windov	v Help			
Stimulus		S	tart 2.35	0000000 (GHz ÷	Start		Stop	Cen	ter	Span
<mark>811</mark> 5.000dB/ Tr1 0.00dB LogM	5.00 0.00	Tr1 dB S11	Sdd	11 & Sdd2	2 OdB is a	: Sdd12 -1	DdB	1: > 2:	2.400000 2.480000		-11.389 dB -10.263 dB
	-5.00										
	-10.00							2			
	-15.00			1			~				
	-20.00										
	-25.00										
	-30.00										
	-35.00										
	40.00										
	45.00	Ch1: Start	2 35000	GHz —						Stop 2	.55000 GHz
Cont. CH 1		orn. oran	2.00000	No Cor						0.00 2	LCL

Figure 3. Test Board #3-08 S11 response

These results all fall within the range of acceptable values, with peak return loss in excess of 20dB and centered on the frequencies of interest. These were hand assembled boards, with significant variations in solder thickness, mask registration, and component placement. Production units are likely to show much less variance in performance.

Conclusions.

- 1. The design and component values for the matching circuit are validated to provide acceptable performance.
- 2. Release to production with the component values tested here and a layout based on "RF3" is approved.
- 3. Intentional radiator FCC certification will still apply, because we are using the same antenna that the certification used.

- 4. Johanson reported that the AT8010 antenna is suboptimal for location parallel to and this close to the groundplane. If a suitable opportunity arises, it may be possible to improve performance and efficiency by using their suggested replacement.
- 5. As long as we use an antenna with gain less than or equal to the AT8010 (the suggested Johanson replacement fits this description), it is legitimate to continue to apply the certification.

As always raw data & plots is available upon request.